J617 Rec'd PCT/PTO 20 APR 20

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U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER
10191/1825

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
09/830067

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE(S) CLAIMED
PCT/DE99/02140	(10.07.1999) 10 July 1999	(21.10.98) 21 October 1998

TITLE OF INVENTION
RADIO RECEIVING SYSTEM AND METHOD OF OPERATING SAME

APPLICANT(S) FOR DO/EO/US

ENGEL, Gerhard

Applicant(s) herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (unsigned).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
    ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☒ A substitute specification and a marked-up version of the substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: International Search Report, Preliminary Examination Report, and Form PCT/RO/101.

Express Mail No.

JC18 Rec'd PCT/PTO 2 0 APR 20

U.S. APPLICATION NO if known, see 37 C.F.R.1.5	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/830067	PCT/DE99/02140	10191/1825

17. ☒ The following fees are submitted:

	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO .... $860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) ... $690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) .... $710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... $1,000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =	0	X $18.00	$ 0	
Independent Claims	2 - 3 =	0	X $80.00	$ 0	
Multiple dependent claim(s) (if applicable)			+ $270.00	$ 0	

TOTAL OF ABOVE CALCULATIONS =	$ 860	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).	$	
SUBTOTAL =	$ 860	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +	$	
TOTAL NATIONAL FEE =	$ 860	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +	$	
TOTAL FEES ENCLOSED =	$ 860	
	Amount to be: refunded	$
	charged	$

a. ☐ A check in the amount of $________ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of $860.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Richard Mayer By [signature] Reg. No. 33,865 (DEPOSIT)

SIGNATURE

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Richard L. Mayer, Reg. No. 22,490
NAME

4/20/2001
DATE

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PATENT TRADEMARK OFFICE

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[10191/1825]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	Gerhard ENGEL
Serial No.	:	To Be Assigned
Filed	:	Herewith
For	:	RADIO RECEIVING SYSTEM AND METHOD OF OPERATING SAME
Art Unit	:	To Be Assigned
Examiner	:	To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT AND
37 C.F.R. § 1.125 SUBSTITUTE SPECIFICATION STATEMENT

SIR:

Please amend without prejudice the above-identified application before examination, as set forth below.

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract, but without claims) accompanies this response. It is respectfully requested that the Substitute Specification (including Abstract) be entered to replace the Specification of record.

IN THE CLAIMS:

Without prejudice, please cancel original claims 1 to 8 and substitute claims 1 to 8, and please add new claims 9 to 18 as follows:

--9. (New) A radio receiving system comprising:

a radio data system (RDS) radio receiver, the RDS radio receiver including a processor for ascertaining a radio data system error rate and for controlling at least one switching operation dependent on the radio data system error rate;

a plurality of receiving antennas; and

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an antenna switching system for performing the at least one switching operation from one antenna of the plurality of receiving antennas to another antenna of the plurality of receiving antennas being connected to the processor, each of the plurality of receiving antennas being connectable to the RDS radio receiver via the antenna switching system.

10. (New) The radio receiving system of claim 9, wherein the processor includes a control device having a control line.

11. (New) The radio receiving system of claim 10, wherein the control line includes a single control wire for transmitting different currents to the antenna switching system as switching commands.

12. (New) The radio receiving system of claim 11, wherein the different currents include at least one of 0 mA, 2 mA, 4 mA and 6 mA.

13. (New) The radio receiving system of claim 9, further comprising an interface for evaluating a control command of the processor, wherein the interface is disposed between the antenna switching system and the processor.

14. (New) The radio receiving system of claim 10, wherein the antenna switching system includes a plurality of high frequency switching units, each of the plurality of high frequency units being connectable to each of the plurality of receiving antennas and the processor via the control device.

15. (New) The radio receiving system of claim 14, wherein at least one of the plurality of high frequency switching units includes one of a coaxial relay and a PIN diode high frequency switch.

16. (New) A method for operating a radio receiving system, the method comprising the steps of:

ascertaining a radio data system error rate of a radio data system (RDS) radio receiver;

controlling at least one switching operation dependent on the radio data system error rate; and

performing at least one switching operation from one antenna of a plurality of receiving antennas to another antenna of the plurality of receiving antennas being connected to the processor of the RDS radio receiver by using an antenna switching system, each of the plurality of receiving antennas being connectable to the RDS radio receiver via the antenna switching system.

17. (New) The method of claim 16, further comprising the step of transmitting varying currents from the processor to the antenna switching system for switching among different ones of the plurality of receiving antennas.

18. (New) The method of claim 17, wherein the varying currents include at least one of 0 mA, 2 mA, 4 mA and 6 mA.--.

Remarks

This Preliminary Amendment cancels without prejudice original claims 1 to 8 and substitute claims 1 to 8 in the underlying PCT Application No. PCT/DE99/02140, and adds without prejudice new claims 9 to 18. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

In accordance with 37 C.F.R. § 1.121(b)(3), the Substitute Specification (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to U.S. Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. § 1.121(b)(3)(iii) and § 1.125(b)(2), a Marked Up Version Of Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. In the Marked Up Version, shading indicates added text and brackets indicated deleted text. Approval and entry of the Substitute Specification (including Abstract) is respectfully requested.

The underlying PCT Application No. PCT/DE99/02140 includes an International Search Report, dated February 2, 2000. The Search Report includes a list of documents that were uncovered in the underlying PCT Application. A copy of the Search Report accompanies this Preliminary Amendment.

The underlying PCT application also includes an International Preliminary Examination Report, dated October 20, 2000, and an annex. An English translation of the International Preliminary Examination Report and the annex accompanies this Preliminary Amendment.

Applicant asserts that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

KENYON & KENYON

Dated: 4/20/2001

By: _____

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[10191/1825]

RADIO RECEIVING SYSTEM AND METHOD OF OPERATING SAME

Field of the Invention

The present invention relates to a radio receiving system having a radio data system radio receiver (RDS radio receiver) having an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system, according to the generic part of Claim 1. The present invention further relates to a method of operating a radio receiver system having a radio data system radio receiver (RDS radio receiver), an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system, according to the generic part of Claim 7.

Background Information

In radio receivers having an evaluation unit for the radio data system (RDS radio receiver), as, for example, RDS auto radios, it is known, during poor signal or receiving quality, to conduct a test for alternative frequencies (AF), and possibly to change to an alternative frequency (AF) if it yields a better signal or receiving quality.

The so-called RDS (radio data system) signal is used with wireless program broadcasts, for example, of radio programs for travelers in a motor vehicle equipped with a corresponding RDS auto radio, for transmitting various important data, with which the RDS auto radio carries out, independently and

automatically, among other things, a plurality of operations necessary for interference free reception, without, for example, a driver having to divert his attention from the road traffic and having to make manual inputs into the RDS auto radio. In that regard, an RDS processor, provided in the RDS auto radio, carries out an RDS-controlled selection of an actual reception frequency. In this process, for example, alternative frequencies stored in an alternative frequency list are checked regularly, and signal strength, signal quality as well as an RDS error rate are evaluated, and that particular reception frequency is set in the RDS auto radio, which offers optimal broadcast reception in consideration of the aforesaid measured values.

In broadcast receivers having a plurality of reception antennas it is also a matter of knowledge to provide an antenna switching system, which, analogously to the RDS processor, checks a signal strength and a signal quality coming in over a specific reception antenna, and selects and connects to the broadcast receiver the particular reception antenna which guarantees optimal reception. But here the disadvantage is, that in an RDS auto radio having a plurality of reception antennas, and an antenna switching system for automated switching among the reception antennas, the processes of antenna switching and alternative frequency selection are two competing operations independent of each other. The antenna switching system also does not evaluate an RDS error rate. Therefore, these two systems work in uncoordinated fashion, although they do influence each other in their effect on reception quality. In borderline situations, the result can be a deterioration of reception instead of an aimed-at improvement.

Description of the Present Invention, Object, Solution, Advantages

It is the object of the present invention to provide an improved radio reception system of the kind named above, and a corresponding method for operating the same, while removing the disadvantages named above.

The object of the present invention is achieved by a radio receiving system of the type mentioned above, having the features indicated in Claim 1, and by a method of the type mentioned above, having the features denoted in Claim 7.

To accomplish this, in a radio reception system of the type named above, the present invention provides that the antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna shall be directly connected to the RDS processor via a control device.

This has the advantage that a particular antenna selection takes place even under consideration of an RDS error rate checked by the RDS processor, and therefore being substantially more accurate, the antenna selection by the antenna switching system and a reception frequency selection by the RDS processor being no longer two competing, independent processes, but the antenna selection being integrated into the RDS strategy. This avoids, for example, problems which would arise from different time constants of the processes named.

Preferred further developments of the radio receiver system are described in Claims 2 through 6.

In a preferred specific embodiment, the control device includes a control line which has, in particular, a single control wire, which transmits different currents, for instance, 0 mA, 2 mA, 4 mA, or 6 mA to the antenna switching system as switching commands.

An interface is preferably positioned between the antenna switching system and the RDS processor for evaluating control commands of the RDS processor.

In order to have loss-free and operationally safe switching between the receiving antennas, the antenna switching system includes, for each receiving antenna, an HF switching unit connected to it and the RDS processor via the control device, which is, for example, a coaxial relay or a PIN diode-HF switch.

Furthermore, in a method of the type named above, the present invention provides that the antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna shall be controlled by the RDS processor.

This has the advantage that the selection of any particular antenna is made even under consideration of an RDS error rate checked by the RDS processor, and therefore substantially more accurately, the antenna selection being no longer made up of two competing, independent processes, because of the antenna switching system and a reception frequency selection, but rather the antenna selection being integrated into the RDS strategy. This avoids, for example, problems which would arise from different time constants of the processes named.

A preferred further development of the method is described in Claim 8.

In one preferred further development of the method, a control current of 0 mA, 2 mA, 4 mA, or 6 mA is transmitted from the RDS processor to the antenna switching system for the purpose of switching among various receiving antennas.

Brief Description of the Drawings

With the aid of the enclosed drawing, the present invention is described in more detail. This shows, in the only Figure, a schematic block diagram of a preferred embodiment of the radio receiving system according to the present invention.

The Best Way to Execute the Present Invention

The preferred embodiment, shown in the only Figure, of a radio receiving system 100, according to the present invention, includes an RDS (Radio Data System) radio receiver 10, an antenna switching system 12 and a plurality of alternative receiving antennas 14. The RDS radio receiver 10 has an RDS processor 16, an antenna input 18 and a control line output 20. The antenna switching system 12 is connected to the receiving antennas 14 via the respective amplifiers 21 and the respective HF switching units 22, 24, 26, and 28. The HF switching units 22, 24, 26 and 28 are each connected to antenna input 18 of the RDS radio receiver 10 via a common amplifier 30. By the corresponding selection of the setting of the HF switching units 22, 24, 26 and 28, a desired receiving antenna 14 can be connected to antenna input 18 of radio receiver 10.

The HF switching units are connected to an interface 34 via the respective lines 32, for carrying out the respective switching processes from one receiving antenna 14 to another receiving antenna 14. This interface 34 is coupled with control line output 20 of the RDS radio receiver 10 via a single control line 36. According to the present invention, the RDS processor 16 checks signal strength, signal quality and an RDS error rate not only for different alternative frequencies, but also for different receiving antennas 14. For this, the RDS processor 16 gives a corresponding control command via control line 36 to interface 34, which, corresponding to this control command, switches the HF control units via the lines 32 in such a way that a desired receiving antenna 14 is connected to antenna input 18 of RDS radio receiver 10. By evaluating the measured values for signal strength, signal quality and RDS error rate, the RDS processor selects an optimal alternative frequency as well as an optimal receiving antenna 14. This selected receiving antenna 14 is connected to antenna input 18 of the RDS radio receiver 10 by a corresponding control command via control line 36 to the interface 34.

The control command transmitted from the RDS processor via control line 36 is, for example, a control current which may assume a value such as 0 mA, 2 mA, 4 mA or 6 mA. In this connection, for example, the interface 34 switches the HF switching unit 22 to pass, and the remaining HF switching units 24, 26, 28 to block, when the control current has the value 0 mA, so that the left antenna 14 in the only Figure is connected to antenna input 18 of the RDS radio receiver 10. In an analogous manner, interface 34 switches HF switching unit 24 to pass and the remaining HF switching units 22, 26, 28 to

block when the control current has the value 2 mA, switches HF switching unit 26 to pass and the remaining HF switching units 22, 24, 28 to block, when the control current has the value 4 mA, or switches the HF switching unit 28 to pass and the remaining switching units 22, 24, 26 to block when the control current has the value 6 mA. In this manner, it can be seen that always exactly one receiving antenna 14 is connected to the antenna input 18 of the RDS radio receiver 10.

Thus, selecting the antenna is done, according to the present invention, not independently by the antenna switching system, but rather centrally controlled by the RDS processor, which also selects an alternative frequency. In other words, the selection of the best receiving antenna 14 is transmitted to an additional software routine in RDS processor 16. On account of this, an RDS error rate is also considered jointly with the antenna selection, which reacts substantially more sensitively to changing reception conditions than does the signal strength or the signal quality. Through this, antenna switching can occur even earlier, that means, before a listener can perceive a change or a deterioration of an audio signal emitted from the RDS radio receiver. An antenna evaluation set of statistics simultaneously kept in the background makes possible minimizing the switchover operations and interfering noise caused by them. The HF switching units 22, 24, 26, 28, provided for bringing together the, for example, four antenna signals to the sole antenna input 18 of the RDS radio receiver 10, may be, for instance, switching elements in the form of coaxial relays or PIN diodes-HF switch.

For rapid switching, in the preferred specific embodiment depicted, a single-wire control interface 20, 36, 34 to the

above-mentioned four different control signals 0 mA, 2 mA, 4 mA and 6 mA is provided. These control signals are generated, for example, by a controlled current source, not shown, and are decoded using a voltage divider, not shown, and an accompanying comparing element. In this manner, a switching control working at high speed over a single line is realized that is safe from interference.

The software solution in the RDS processor 16, mentioned as an example, can easily be integrated into the existing system, without substantial new development of the RDS processor 16 per se, whereby simultaneously the relatively high cost of the independent antenna selection by the antenna switching system 12 is completely eliminated. In particular, a ZF interface, essential to customary antenna switching systems at the RDS radio receiver, becomes superfluous. The total wiring becomes more favorable since a ZF coaxial connection is no longer needed, but rather control of antenna switching is now performed only via a single-wire line.

What is claimed is:

1. A radio receiving system (100) having a radio data system radio receiver (RDS radio receiver (10)), having an RDS processor (16) and a plurality of receiving antennas (14) connected to the RDS radio receiver (10) via an antenna switching system (12), the antenna switching system (12) for carrying out switching operations from one receiving antenna (14) to another receiving antenna being connected to the RDS processor (16), wherein the RDS processor (16) is designed to ascertain an RDS error rate and to control the switching operations in dependence on the RDS error rate, as well.

2. The radio receiving system (100) as recited in Claim 1, wherein the control device includes a control line (36).

3. The radio receiving system (100) as recited in Claim 1, wherein the control line (36) includes a single control wire which transmits different currents, for instance, 0 mA, 2 mA, 4 mA, or 6 mA to the antenna switching system (12) as switching commands.

4. The radio receiving system (100) as recited in one of the preceding Claims, wherein an interface (34) for evaluating control commands of the RDS processor (16) is positioned between the antenna switching system (12) and the RDS processor (16).

5. The radio receiving system (100) as recited in one of the preceding Claims, wherein the antenna switching system (12) includes for each receiving antenna (14) an HF

switching unit (22, 24, 26, 28) connected to it and the RDS processor (16) via the control device (34, 36).

6. The radio receiving system (100) as recited in Claim 5, wherein at least one HF switching unit (22, 24, 26, 28) is a coaxial relay or a PIN diode HF switch.

7. A method for operating a radio receiving system having a radio data system radio receiver (RDS radio receiver), an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system, the antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna being controlled by the RDS processor, wherein the control unit controls the switching operations in dependence on an RDS error rate, as well.

8. The method as recited in Claim 7, wherein varying currents of, for example, 0 mA, 2 mA, 4 mA, or 6 mA are transmitted from the RDS processor to the antenna switching system for the purpose of switching among different receiving antennas.

Abstract

The present invention relates to a radio receiving system (100) having a radio data system radio receiver (RDS radio receiver (10)), having an RDS processor (12) and a plurality of receiving antennas (14) connected to the RDS radio receiver (10) via an antenna switching system (12). In this connection, the antenna switching system (12) for carrying out switching operations from one receiving antenna (14) to another receiving antenna (14) is directly connected to the RDS processor (16) via a control device (36, 34)

(Figure)

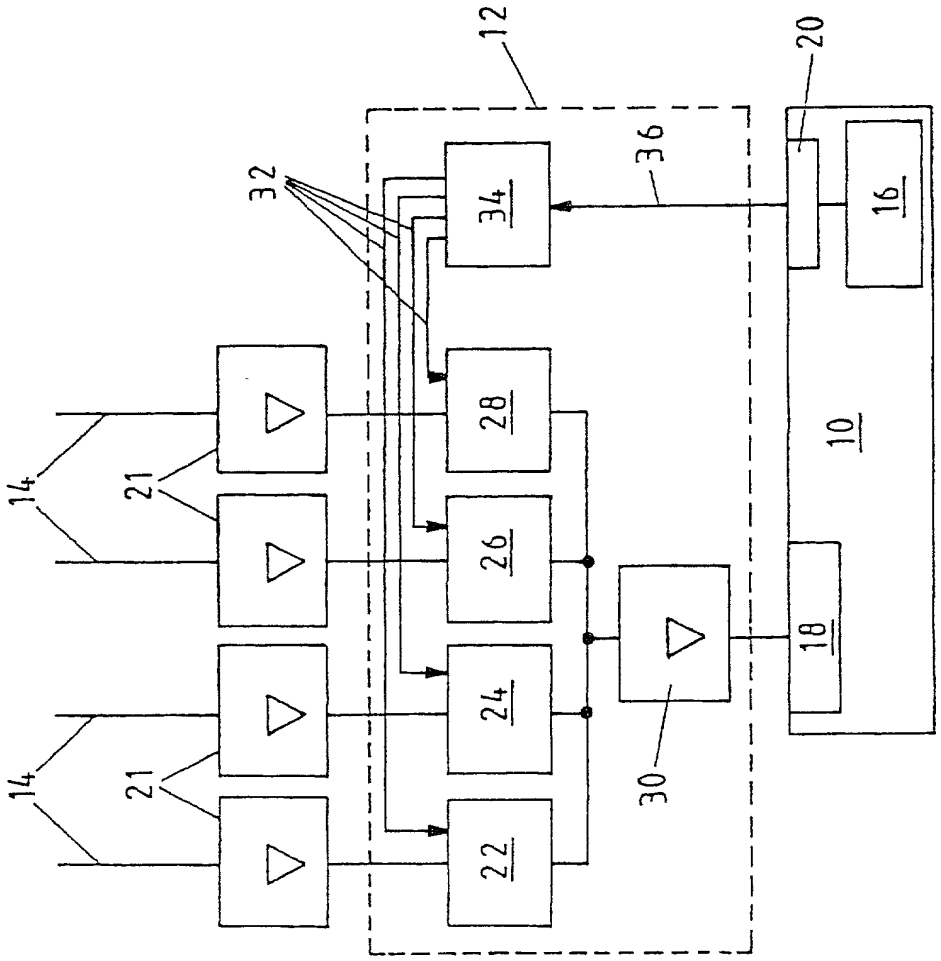

Fig.

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RADIO RECEIVING SYSTEM AND METHOD OF OPERATING SAME

FIELD OF THE INVENTION

The present invention relates to a radio receiving system and a method of operating a radio receiving system having a radio data system radio receiver (RDS radio receiver) having an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system.

BACKGROUND INFORMATION

In radio receivers having an evaluation unit for the radio data system (RDS radio receiver), for example, RDS auto radios, during poor signal or receiving quality a test for alternative frequencies (AF) may be conducted and possibly a change to an alternative frequency may be made if such change yields a better signal or receiving quality.

The so-called RDS (radio data system) signal is used with wireless program broadcasts, for example, of radio programs for travelers in a motor vehicle equipped with a corresponding RDS auto radio, for transmitting various data, with which the RDS auto radio carries out, independently and automatically, among other things, a plurality of operations necessary for interference free reception, without, for example, a driver having to divert his attention from the road traffic and having to make manual inputs into the RDS auto radio. In that regard, an RDS processor, provided in the RDS auto radio, carries out an RDS-controlled selection of an actual reception frequency.

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In this process, for example, alternative frequencies stored in an alternative frequency list are checked regularly, and signal strength, signal quality as well as an RDS error rate are evaluated, and that particular reception frequency is set in the RDS auto radio, which offers optimal broadcast reception in consideration of the aforesaid measured values.

In broadcast receivers having a plurality of reception antennas, there is provided an antenna switching system, which, analogously to the RDS processor, checks a signal strength and a signal quality coming in over a specific reception antenna, and selects and connects to the broadcast receiver the particular reception antenna which guarantees optimal reception. However, in an RDS auto radio having a plurality of reception antennas and an antenna switching system for automated switching among the reception antennas, the processes of antenna switching and alternative frequency selection are two competing operations independent of each other. The antenna switching system also does not evaluate an RDS error rate. Therefore, these two systems work in uncoordinated fashion, although they do influence each other in their effect on reception quality. In borderline situations, the result can be a deterioration of reception instead of an aimed-at improvement.

SUMMARY OF THE INVENTION

An exemplary embodiment of the present invention is directed to providing an improved radio reception system and a corresponding exemplary method for operating the same.

The exemplary embodiment of the present invention provides that the antenna switching system for carrying out switching

operations from one receiving antenna to another receiving antenna can be directly connected to the RDS processor via a control device.

The exemplary embodiment of the present invention further provides that an antenna selection can take place even under consideration of an RDS error rate checked by the RDS processor. It is believed that this provides a substantially more accuracy and the antenna selection by the antenna switching system and a reception frequency selection by the RDS processor are no longer two competing, independent processes. Instead, the antenna selection is integrated into the RDS strategy. This can avoid, for example, problems which would arise from different time constants of the processes named.

In another exemplary embodiment of the present invention, the control device includes a control line which has, in particular, a single control wire, which transmits different currents, for instance, 0 mA, 2 mA, 4 mA, or 6 mA to the antenna switching system as switching commands.

In another exemplary embodiment of the present invention, an interface can be positioned between the antenna switching system and the RDS processor for evaluating control commands of the RDS processor.

In order to have loss-free and operationally safe switching between the receiving antennas, the antenna switching system can include, for each receiving antenna, an HF switching unit connected to it and the RDS processor via the control device, which is, for example, a coaxial relay or a PIN diode-HF switch.

Another exemplary embodiment of the present invention provides that the antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna can be controlled by the RDS processor.

In exemplary embodiments and/or methods of the present invention, the selection of an antenna can be made even under consideration of an RDS error rate checked by the RDS processor, and therefore substantially more accurately. The antenna selection in this case is not made up of two competing, independent processes because of the antenna switching system and a reception frequency selection and the antenna selection is integrated into the RDS strategy. Thus, it is believed that problems can be avoided that would arise from different time constants of the processes named.

In another exemplary method of the present invention, a control current of 0 mA, 2 mA, 4 mA, or 6 mA is transmitted from the RDS processor to the antenna switching system for the purpose of switching among various receiving antennas.

BRIEF DESCRIPTION OF THE DRAWING

The Figure shows a schematic block diagram of an exemplary embodiment of the radio receiving system according to the present invention.

DETAILED DESCRIPTION

Referring to the Figure, an exemplary embodiment of a radio receiving system 100 according to the present invention is shown and includes an RDS (Radio Data System) radio receiver 10, an antenna switching system 12 and a plurality of alternative receiving antennas 14. The RDS radio receiver 10

can have an RDS processor 16, an antenna input 18 and a control line output 20. The antenna switching system 12 may be connected to the receiving antennas 14 via the respective amplifiers 21 and the respective HF switching units 22, 24, 26, and 28. The HF switching units 22, 24, 26 and 28 can each be connected to antenna input 18 of the RDS radio receiver 10 via a common amplifier 30. By the corresponding selection of the setting of the HF switching units 22, 24, 26 and 28, a desired receiving antenna 14 can be connected to antenna input 18 of radio receiver 10.

The HF switching units can be connected to an interface 34 via the respective lines 32, for carrying out the respective switching processes from one receiving antenna 14 to another receiving antenna 14. The interface 34 may be coupled with control line output 20 of the RDS radio receiver 10 via a single control line 36. According to the exemplary embodiment of the present invention, the RDS processor 16 can check signal strength, signal quality and an RDS error rate not only for different alternative frequencies, but also for different receiving antennas 14. For this, the RDS processor 16 gives a corresponding control command via control line 36 to interface 34, which, corresponding to this control command, switches the HF control units via the lines 32 in such a way that a desired receiving antenna 14 is connected to antenna input 18 of RDS radio receiver 10. By evaluating the measured values for signal strength, signal quality and RDS error rate, the RDS processor can select an optimal alternative frequency as well as an optimal receiving antenna 14. This selected receiving antenna 14 can be connected to antenna input 18 of the RDS radio receiver 10 by a corresponding control command via control line 36 to the interface 34.

The control command transmitted from the RDS processor via control line 36 can be, for example, a control current which may assume a value such as 0 mA, 2 mA, 4 mA or 6 mA. In this connection, for example, the interface 34 switches the HF switching unit 22 to pass and the remaining HF switching units 24, 26, 28 to block, when the control current has the value 0 mA, so that the left antenna 14 in the Figure is connected to antenna input 18 of the RDS radio receiver 10. In an analogous manner, interface 34 switches HF switching unit 24 to pass and the remaining HF switching units 22, 26, 28 to block when the control current has the value 2 mA. Likewise, the interface 34 switches HF switching unit 26 to pass and the remaining HF switching units 22, 24, 28 to block when the control current has the value 4 mA. Likewise, the interface switches the HF switching unit 28 to pass and the remaining switching units 22, 24, 26 to block when the control current has the value 6 mA. In this manner, it can be seen that always exactly one receiving antenna 14 is connected to the antenna input 18 of the RDS radio receiver 10.

According to the exemplary embodiments of the present invention, selection of the antenna is done, not independently by the antenna switching system, but rather centrally controlled by the RDS processor, which also selects an alternative frequency. In other words, the selection of the best receiving antenna 14 is transmitted to an additional software routine in RDS processor 16. On account of this, an RDS error rate is also considered jointly with the antenna selection, which reacts substantially more sensitively to changing reception conditions than does the signal strength or the signal quality. Through this, antenna switching can occur even earlier, that means before a listener can perceive a

change or a deterioration of an audio signal emitted from the RDS radio receiver. An antenna evaluation set of statistics simultaneously kept in the background makes possible minimizing the switchover operations and interfering noise caused by them. The HF switching units 22, 24, 26, 28, provided for bringing together, for example, the four antenna signals to the sole antenna input 18 of the RDS radio receiver 10, may be, for instance, switching elements in the form of coaxial relays or PIN diodes-HF switch.

In exemplary embodiments of the present invention, for rapid switching, a single-wire control interface 20, 36, 34 to the above-mentioned four different control signals 0 mA, 2 mA, 4 mA and 6 mA can be provided. These control signals can be generated, for example, by a controlled current source and can be decoded using a voltage divider and an accompanying comparing element. In this manner, a switching control working at high speed over a single line can be realized that is safe from interference.

The software solution in the RDS processor 16, for example, can easily be integrated into the existing system, without substantial new development of the RDS processor 16, whereby simultaneously the relatively high cost of the independent antenna selection by the antenna switching system 12 may be completely eliminated. In particular, a ZF interface, essential to customary antenna switching systems at the RDS radio receiver, can become superfluous. The total wiring can become more favorable since a ZF coaxial connection is no longer needed, but rather control of antenna switching can now be performed only via a single-wire line.

ABSTRACT OF THE DISCLOSURE

A radio receiving system having a radio data system radio receiver (RDS radio receiver), having an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system. The antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna can be directly connected to the RDS processor via a control device.

Declaration and Power of Attorney

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DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **RADIO RECEIVING SYSTEM AND METHOD OF OPERATING SAME,** the specification of which was filed as PCT International Application Number PCT/DE99/02140 on July 10, 1999.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

EL 302 703 946

PRIOR FOREIGN APPLICATION(S)

Number	Country filed	Day/month/year	Priority Claimed Under 35 USC 119
198 48 360.0	Fed. Rep. of Germany	21 October 1998	Yes

And I hereby appoint Richard L. Mayer (Reg. No. 22,490) and Gerard A. Messina (Reg. No. 35,952) my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful and false statements may jeopardize the validity of the application or any patent issued thereon.

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